

3.0 SHEPLEY'S HILL LANDFILL OPERABLE UNIT (AOCs 4, 5, AND 18) FIVE-YEAR SITE REVIEW

3.1 SITE DESCRIPTION AND HISTORY

Shepley's Hill Landfill encompasses approximately 84 acres in the northeast corner of the former Main Post at Fort Devens (Figure 1-1). It is situated between the bedrock outcrop of Shepley's Hill on the west and Plow Shop Pond on the east. Nonacoicus Brook, which drains Plow Shop Pond, flows through a low-lying wooded area at the north end of the landfill. The southern end of the landfill borders the former Defense Reutilization and Marketing Office (DRMO) yard and a former warehouse area. This area is currently undergoing extensive construction as part of Devens redevelopment activities. An area east of the landfill and south of Plow Shop Pond is the site of a former railroad roundhouse. Shepley's Hill Landfill includes three AOCs: AOC 4, the sanitary landfill incinerator; AOC 5, sanitary landfill No. 1 or Shepley's Hill Landfill; and AOC 18, the asbestos cell. AOCs 4, 5, and 18 are all located within the capped area at Shepley's Hill Landfill. The three AOCs are collectively referred to as Shepley's Hill Landfill.

Review of the surficial geology map of the Ayer Quadrangle shows that in the early 1940s, the active portion of the landfill consisted of approximately 5 acres near the end of Cook Street, near where monitoring well SHL-1 is located (Jahns, 1953). The fill was elongated north-south along a pre-existing small valley containing at least two areas mapped as swamps (probably kettle holes) and lying between the bedrock outcrop of Shepley's Hill to the west and a flat-topped kame terrace with an elevation of approximately 250 feet to the east, next to Plow Shop Pond. During the landfilling operation, the valley was filled-in, and much of the kame terrace, which may have been used as cover material, was removed. Background information indicates the landfill once operated as an open burning site.

Landfill operations at Shepley's Hill Landfill began at least as early as 1917, and stopped as of July 1, 1992. During its last few years of use, the landfill received about 6,500 tons per year of household refuse and construction debris, and operated using the modified trench method. There is evidence that trenches in the northwest portion cut into previously used areas containing glass and spent shell casings. The glass dated from the mid-nineteenth century to as late as the 1920s. Based on boring logs for piezometer nests N5, N6, and N7, which were installed through the landfill cap, the approximate elevation of the bottom of the waste is estimated to be 217 and 214 feet above sea level at the deepest areas in the north end and in the central portion of the landfill, and 224 to 229 feet above sea level in the southeast portion of the landfill. Based on the boring logs, the maximum depth of the refuse occurs near piezometer N6 in the central portion of the landfill and is estimated to be about 40 feet. The average thickness of waste is not documented; however, if the average thickness were 10 feet, the landfill volume would be over 1,300,000 cy. Reports of flammable fluid disposal in the southeastern portion of the landfill have not been substantiated by observations in test pits or other research. The Army has no evidence that hazardous wastes were disposed of in the landfill after November 19, 1980. No waste hot spots or hazardous waste disposal areas were identified during RI or supplemental RI activities.

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In an effort to mitigate the potential for off-site contaminant migration, Fort Devens initiated the Fort Devens Sanitary Landfill Closure Plan in 1984 in accordance with Massachusetts regulations entitled "The Disposal of Solid Wastes by Sanitary Landfill" (310 CMR 19.00, April 21, 1971). The MADEP (then the Department of Environmental Quality Engineering) approved the plan in 1985. Closure plan approval was consistent with 310 CMR 19.00 and contained the following requirements:

- grading the landfill surface to a minimum 2 percent slope in non-operational areas of the landfill and 3 percent in operational areas;
- removing waste from selected areas within 100 feet of the 100-year floodplain;
- installing a gas venting system;
- installing a low permeability cap and covering the cap with sand, gravel, and loam, and seeding to provide cover vegetation and prevent erosion; and
- implementing a groundwater monitoring program based on sampling five existing monitoring wells every four months.

The capping was completed in four phases (Figure 3-1). In Phase I, 50 acres were capped in October 1986; in Phase II, 15 acres were capped in November 1987; and in Phase III, 9.2 acres were capped in March 1989. The Phase IV closure of the last 10 acres was accomplished in two steps: Phase IV-A was closed in 1991, and Phase IV-B was closed as of July 1, 1992, although the geomembrane cap was not installed over Phase IV-B until May 1993.

Because of the large area and shallow surface slope of the existing landfill, early phases of the landfill closure were completed with a 2 or 3 percent surface slope. Slopes were increased to 5 percent in Phase IV-B. Phases I through IV-A were capped with a 30-mil polyvinyl chloride (PVC) geomembrane overlain with a 12-inch drainage layer and 6-inch topsoil layer. At the request of MADEP, the Phase IV-B cap design was modified to include a 40-mil PVC geomembrane, a 6-inch drainage layer, and a 12-inch topsoil layer. A landfill-gas collection system consisting of 3-inch diameter gas-collection pipes bedded in a minimum 6-inch thick gas-venting layer was installed beneath the PVC geomembrane in all closure phases. Gas vents were installed through the PVC geomembrane at 400-foot centers. A minimum 6-inch cushion/protection layer was maintained between the geomembrane and underlying waste. As requested by USEPA and MADEP, four additional groundwater monitoring wells were installed in 1986 to supplement the five in the original groundwater program. The Army submitted a draft closure plan to MADEP on July 21, 1995, pursuant to 310 CMR 19.000, to document that Shepley's Hill Landfill was closed in accordance with plans and applicable MADEP requirements.

AOC 4, the sanitary landfill incinerator was located in former Building 38 near the end of Cook Street within the area included in Phase I of the sanitary landfill closure. The incinerator was constructed in 1941, burned household refuse, and operated until the late 1940s. Ash from the incinerator was buried in the landfill. The incinerator was demolished and buried in the landfill in September 1967. The building foundation was removed and buried on-site in 1976.

AOC 18, the asbestos cell, is located in the section of the landfill closed during Phase IV.

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Between March 1982 and November 1985, an estimated 6.6 tons of asbestos construction debris were placed in the section of the landfill closed during Phase IV-A. In 1990, a new asbestos cell was opened in the section closed during Phase IV-B, and was used until July 1992 for disposal of small volumes of asbestos-containing material.

The Army performed an RI and supplemental RI at Shepley's Hill Landfill in accordance with CERCLA between 1991 and 1993 (E&E, 1993; ABB-ES, 1993)). The RI and RI Addendum reports identified potential human exposure to arsenic in groundwater as the primary risk at Shepley's Hill Landfill. The RI Addendum Report also identified potential ecological risks to aquatic and semi-aquatic receptors from exposure to Plow Shop Pond surface water and sediments.

A FS was performed in 1995 to evaluate alternatives to reduce potential exposure risks associated with human exposure to Shepley's Hill Landfill Operable Unit groundwater, and in September 1995, a ROD was finalized (ABB-ES, 1995a; ABB-ES, 1995b). The Plow Shop Pond Operable Unit was established to evaluate actions to manage risk from exposure to Plow Shop Pond surface water and sediment. In 1995, the Army designated Plow Shop Pond as AOC 72.

The following table summarizes important events and dates at Shepley's Hill Landfill Operable Unit.

EVENT	DATE
Ft. Devens placed on NPL	December 1989
Waste disposal at Shepley's Hill Landfill ends	July 1, 1992
Landfill capping complete	May 1993
RI complete	1993
Supplemental RI complete	1993
FS complete	February 1995
ROD signature	September 1995
Long-term Monitoring and Maintenance Plan complete	May 1996
Long-term monitoring begins	November 1996
60% Extraction design complete	November 1997
First Shepley's Hill Landfill Five-year Review complete	August 1998

A more complete description of the Shepley's Hill Landfill Operable Unit can be found in the RI Addendum report, (ABB-ES, 1993), and the FS report, (ABB-ES, 1995a).

3.2 REMEDIAL OBJECTIVES

Based on types of contaminants, environmental media of concern, and potential exposure pathways, remedial response objectives were developed in the FS to aid in the development and screening of alternatives (ABB-ES, 1995a). These remedial response objectives were developed to mitigate existing and future potential threats to public health and the environment. The response objectives for the Shepley's Hill Landfill Operable Unit are:

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- Protect potential residential receptors from exposure to contaminated groundwater migrating from the landfill having chemicals in excess of MCLs.
- Prevent contaminated groundwater from contributing to the contamination of Plow Shop Pond sediments in excess of human-health and ecological risk-based concentrations.

Response objectives were not identified for surface soil, landfill gas, or leachate. The risk assessments did not identify potential risks from exposure to surface soil, and ambient air monitoring during the RI did not identify airborne contaminants. Liquid leachate was not identified during either RI or supplemental RI activities. The Plow Shop Pond Operable Unit was established to evaluate additional actions to manage risk from exposure to Plow Shop Pond surface water and sediment. The Army performed extensive surface water and sediment chemical characterization as well as sediment toxicity characterization in Plow Shop Pond and Grove Pond from 1992 through 1995. Results of these studies are reported in the Remedial Investigation Addendum Report (ABB-ES, 1993) and in the Draft Plow Shop Pond and Grove Pond Sediment Evaluation (ABB-ES, 1995c). In 1995, the Army designated Plow Shop Pond as AOC 72.

Groundwater cleanup levels for the Shepley's Hill Landfill Operable Unit were developed following the USEPA guidance documents entitled, Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual (Part B, Development of Risk Based Preliminary Remediation Goals), Interim, December 1991, and OSWER Directive 9355.0-30, Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. This approach identified dichlorobenzenes, 1,2-dichloroethane, arsenic, and manganese as chemicals of concern (COCs) in groundwater. In addition, the baseline risk assessment identified the following COCs as exceeding MCLs or Massachusetts Maximum Contaminant Levels (MMCLs): dichlorobenzenes, 1,2-dichloroethane, arsenic, chromium, and nickel. Concentrations of lead in groundwater exceeded the federal drinking water action level. Concentrations of aluminum and iron exceeded non-risk-based federal and Massachusetts Secondary Maximum Contaminant Levels (SMCLs), while sodium exceeded the federal and Massachusetts guidelines for individuals on a sodium restricted diet.

No MCL or MMCL has been established for manganese. The ROD based the cleanup level for manganese on background concentrations because background concentrations at Devens RFTA exceeded the risk-based concentration derived from the then available reference dose (RfD) (5×10^{-3} milligrams/kilogram/day). A revised/updated RfD (4.7×10^{-2}), available when the Long-term Monitoring and Maintenance Plan was prepared, was used in the Long-term Monitoring and Maintenance Plan to calculate a revised cleanup level for manganese of 1,715 $\mu\text{g/L}$. Because background concentrations for aluminum and iron exceed their respective guideline value, cleanup levels for them were set at the background value. The cleanup level for sodium was set equal to the federal health advisory. The following table summarizes cleanup levels for Shepley's Hill Landfill Operable Unit groundwater.

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CHEMICAL OF CONCERN	CLEANUP LEVEL, $\mu\text{G/L}$	SELECTION BASIS
Arsenic *	50	MCL
Chromium *	100	MCL
1,2-Dichlorobenzene	600	MCL
1,4-Dichlorobenzene *	5	MMCL
1,2-Dichloroethane *	5	MCL
Lead *	15	Action Level
Manganese *	1,715	Risk-based
Nickel *	100	MCL
Sodium	20,000	Health Advisory
Aluminum	6,870	Background
Iron	9,100	Background

* = Trigger chemical

Attainment of cleanup levels in groundwater will result in an approximate sixty-fold reduction in potential human-health risk, reflecting the approximate sixty-fold reduction in arsenic concentrations needed to attain the 50 $\mu\text{g/L}$ arsenic cleanup level. Recent studies indicate that many skin tumors arising from oral exposure to arsenic are non-lethal and that the dose-response curve for the skin cancers may be sublinear (in which case the cancer slope factor used to generate risk estimates may be overestimated). It has been USEPA policy to manage these risks downward by as much as a factor of ten. As a result, the carcinogenic risk for arsenic at Shepley's Hill Landfill Operable Unit has been managed as if it were one order of magnitude lower than the calculated risk. The residual human-health risk from residential exposure to groundwater after attainment of cleanup levels (arsenic cleanup goal of 50 $\mu\text{g/L}$) is estimated to be approximately 1×10^{-3} (unmodified to account for the uncertainty associated with arsenic) and 1×10^{-4} if modified to account for the uncertainty associated with exposure to arsenic.

3.3 DESCRIPTION OF REMEDY

The ROD identified Alternative SHL-2: Limited Action to address groundwater contamination at the Shepley's Hill Landfill Operable Unit, with Alternative SHL-9 as the contingency remedy if Alternative SHL-2 proves not to be protective. Each of these alternatives includes components for the containment of landfill wastes and management of contaminant migration. The remedial components of the selected remedy are described in detail below.

Alternative SHL-2 contains components to maintain and potentially improve the effectiveness of the existing landfill cover system and to satisfy the Landfill Post-Closure Requirements of 310 CMR 19.142 to reduce potential future exposure to contaminated groundwater. Key components of this alternative include:

- landfill closure in accordance with applicable requirements of 310 CMR 19.000;
- survey of Shepley's Hill Landfill;
- evaluation/improvement of stormwater diversion and drainage;
- landfill cover maintenance;

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- landfill gas collection system maintenance;
- long-term groundwater monitoring;
- long-term landfill gas monitoring;
- institutional controls;
- educational programs;
- 60 percent design of a groundwater extraction system;
- annual reporting to MADEP and USEPA; and
- five-year site reviews.

Each of these components is described briefly in the following paragraphs.

Landfill Closure in Accordance with Applicable Requirements of 310 CMR 19.000. The ROD required closure of Shepley's Hill Landfill in accordance with Commonwealth of Massachusetts regulations at 310 CMR 19.000. These regulations contain requirements for the submittal to, and approval by, MADEP of plans and supporting materials to document that landfill closure occurs according to approved plans and applicable MADEP requirements.

Survey of Shepley's Hill Landfill. The ROD required an accurate topographic survey of the ground surface at Shepley's Hill Landfill..

Evaluation/Improvement of Stormwater Diversion and Drainage. The ROD required an evaluation of stormwater diversion and drainage systems at and adjacent to Shepley's Hill Landfill. The focus of the evaluation was to include the following items of concern:

- landfill cap runoff patterns and drainage ditch flow capacities;
- potential run-under along the western edge of the landfill, particularly where the existing geomembrane cap may not have a good seal with the underlying bedrock; and
- the effectiveness of stormwater drainage systems upgradient of the landfill (i.e., at the transfer station, tire recycling station, DRMO yards, and along Market Street) at diverting run-off from potential infiltration areas upgradient of the landfill.

Landfill Cover Maintenance. The ROD required development of a Long-term Monitoring and Maintenance Plan to provided details of proposed monitoring and maintenance activities. Of particular concern were drainage of a small area of ponded water in the northwestern section of the landfill, repair of erosion areas at the north end of the landfill, annual inspection of the cover system, and landfill mowing.

Landfill Gas Collection System Maintenance. The ROD required annual inspections to monitor the Shepley's Hill Landfill gas collection system and provide any necessary repairs.

Long-term Groundwater Monitoring. The ROD required development of plans for long-term groundwater monitoring at Shepley's Hill Landfill to alternative performance and assess future environmental effects.

Long-term Landfill Gas Monitoring. The ROD required development of plans for monitoring

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landfill gas at landfill gas vents.

Institutional Controls. The ROD required implementation of institutional controls in the form of zoning and deed restrictions for any property released by the Army at Shepley's Hill Landfill during Fort Devens base-closure activities. The Fort Devens Preliminary Reuse Plan, Main and North Posts has proposed that Army land bordering Plow Shop Pond be zoned for open space and rail-related uses. By pre-empting residential use, these controls would help limit human exposure. In addition, the Army would place deed restrictions on landfill area property to prohibit installation of drinking water wells. This, in combination with landfill capping and long-term groundwater monitoring, would protect potential human receptors from risks resulting from exposure to contaminated groundwater. There are no current human receptors for groundwater exposure. Institutional controls would be drafted, implemented, and enforced in cooperation with state and local governments.

Educational Programs. The ROD required conduct of periodic public meetings and presentations to increase public awareness. This would help keep the public informed of the site status, including both its general condition and remaining contaminant concentrations. This could be accomplished by holding public meetings every five years coincident with the five-year site reviews for Shepley's Hill Landfill. The presentation would summarize site activities and the results of monitoring programs.

60 Percent Design of a Groundwater Extraction System. The ROD required the Army to perform predesign hydrogeologic studies and prepare a 60 percent complete engineering design for groundwater extraction and discharge to the Town of Ayer Publicly Owned Treatment Works (POTW). The 60 percent complete engineering design was to be completed before the Shepley's Hill Landfill five-year review, scheduled for 1998.

Annual Reporting to MADEP and USEPA. The ROD required annual reports to MADEP and USEPA to describe site activities and summarize results of environmental monitoring. This reporting was stipulated to satisfy the requirements of 310 CMR 19.132 and 19.142.

Five-year Site Reviews. The ROD requires the Army to perform five-year reviews to assess whether the implemented remedy is protective of human health and the environment and whether the implementation of additional remedial action is appropriate. Five-year reviews were scheduled for 1998, 2003, and 2008, based on the elapsed time following supplemental RI sampling. The ROD identified cleanup levels for 13 chemicals historically detected in monitoring wells at Shepley's Hill Landfill. Chemicals with MCLs (i.e., 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichloroethane, arsenic, chromium, lead, and nickel) and manganese were identified as trigger chemicals, exceedances of which would justify implementation of contingency remedial action.

Incremental reduction of risk rather than incremental reduction in concentration of individual contaminants was specified as a measure of progress toward attainment of cleanup levels to focus on the cleanup of arsenic, which was the primary contributor to risk. This approach prevents a situation in which failure to attain a concentration reduction goal for a minor contributor to risk

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(e.g., 1,2-dichloroethane) overshadows the achievement of 50 percent or greater reduction in the concentration of arsenic.

The ROD stipulated the following specific criteria for evaluating the effectiveness of the selected remedial action (Alternative SHL-2) at Shepley's Hill Landfill. The criteria for both groups of wells must be met for the alternative to be considered effective.

Group 1 Wells. For Group 1 wells where analyte concentrations have historically attained cleanup levels, Alternative SHL-2 will be considered effective if concentrations of individual chemicals within individual wells do not show statistically significant cleanup level exceedances. To determine statistical significance, the Army will apply methods consistent with the regulations at 40 CFR 264.97, 40 CFR 258.53, and 310 CMR 30.663.

Group 2 Wells. For Group 2 wells where chemical concentrations have exceeded cleanup levels in the past, Alternative SHL-2 will be considered effective if a 50 percent reduction in the increment of risk between cleanup levels and baseline concentrations for COCs within individual wells is achieved by January 1998, if an additional 25 percent (75 percent cumulative) is achieved by January 2003, and if cleanup levels are attained by January 2008.

As outlined in the Long Term Monitoring and Maintenance Plan (SWET, 1996c), for any monitoring well installed subsequent to 1993, not sampled during RI and supplemental RI activities, and showing exceedances of cleanup levels (i.e., a Group 2 well in the ROD), reduction of risk was not evaluated during the first five-year site review following installation. In that instance, analytical data collected between well installation and the next five-year review will be used to calculate baseline concentrations, and risk reduction will be evaluated in subsequent five-year reviews. The evaluation criteria for these wells will be a 50 percent reduction in the increment of risk between cleanup levels and baseline concentrations for COCs in each subsequent five-year review, and attainment of cleanup levels by January 2008. Monitoring wells included in the Shepley's Hill Landfill Five-year Review (SWET, 1998) are listed below and shown in Figure 3-2.

LONG TERM MONITORING AND MAINTENANCE PLAN MONITORING WELLS		
SHL-3	SHL-11	SHM-93-22C
SHL-4	SHL-19	SHM-96-22B
SHL-5	SHL-20	SHM-96-05B
SHL-9	SHL-22	SHM-96-05C
SHL-10	SHM-93-10C	

3.3.1 Current Status

This subsection compares completed and ongoing activities at the Shepley's Hill Landfill Operable Unit with the requirements of the ROD. In addition, recommendations and conclusions

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from the Shepley's Hill Landfill Supplemental Groundwater Report, prepared to address concerns identified in the Final Five-year Report for Shepley's Hill Landfill, are summarized.

Landfill Closure in Accordance with Applicable Requirements of 310 CMR 19.000. The Army submitted a draft closure report for Shepley's Hill Landfill to MADEP in July 1995, and on February 8, 1996, MADEP provided review comments and specific recommendations to address issues of concern. Following review of the MADEP comments, the Army submitted the final closure report in March 1996 pursuant to 310 CMR 19.000 (SWET, 1996b) and the Long Term Monitoring and Maintenance Plan in May 1996 (SWET, 1996c).

Survey of Shepley's Hill Landfill. The landfill surface was surveyed as part of post-closure activities (SWET, 1996a).

Evaluation/Improvement of Stormwater Diversion and Drainage. As part of long-term maintenance activities, the Army has performed extensive maintenance on stormwater ditches at the landfill. Significant portions of drainage ditch have been regraded and seeded or lined with rip-rap stone to reduce erosion.

Potential run-under along the western edge of the landfill was evaluated as part of the Shepley's Hill Landfill Supplemental Groundwater Investigation. Although test pits indicate that run under can occur, soils are sandy and the geomembrane cap does not fit the underlying bedrock surface snugly, the Shepley's Hill Landfill Supplemental Groundwater Report concludes that the effect of potential run under on groundwater elevation and direction of flow is small.

Significant changes to stormwater drainage have been made or are planned for the area south of Shepley's Hill Landfill as part of Devens RFTA redevelopment activities. New segments and modifications to existing segments will discharge stormwater to settling ponds that in turn discharge predominantly away from the area upgradient of the landfill. This is not anticipated to adversely affect groundwater flow beneath the landfill.

Landfill Cover Maintenance. A Long-term Monitoring and Maintenance Plan was prepared for the Shepley's Hill Landfill Operable Unit in 1995 to outline proposed monitoring, maintenance, and reporting activities (SWET, 1996c). Since that time, the Army has performed substantial maintenance on the landfill cap to maintain its integrity and performance. These activities have been documented in annual reports (SWET, 1997a; SWET, 1997b; SWET, 1998; USACE, 1999; USACE, 2000) and have included the following activities as recommended in the annual reports and in the 1998 Five Year Review:

- performing annual inspections of the landfill surface;
- draining a small area of ponded water in the northwestern section of the landfill to minimize stress on the cover system and regrading to prevent future ponding;
- regrading and rip-rapping substantial portions of drainage ditches at the landfill;
- filling animal burrows;
- repairing roads; and
- mowing the landfill vegetative cover.

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Landfill Gas Collection System Maintenance. The above ground portion of the landfill-gas collection system is inspected annually as part of landfill monitoring activities. The gas vents are reported in good condition, and no repairs have been required.

Long-term Groundwater Monitoring. The Long-term Monitoring and Maintenance Plan (SWET, 1996c) outlines the groundwater monitoring program at the landfill. Groundwater monitoring is performed semi-annually at 14 monitoring wells, including SHM-96-05B, SHM-96-05C, and SHM-96-22B which were installed after signature of the ROD. Table 3-1 lists analytical parameters and current analytical methods. Analytical data have been summarized and submitted to USEPA and MADEP annually (SWET, 1997a; SWET, 1997b; SWET, 1998; USACE, 1999; USACE, 2000). Appendix B contains summaries of the data collected during the long-term groundwater monitoring program.

Review of the groundwater analytical data collected in 1996 through 1999 (see Appendix B), shows the presence of VOCs in several monitoring wells at low concentrations; all reported concentrations are below cleanup levels and MCLs, however. Because arsenic is of special concern at Shepley's Hill Landfill, arsenic data are summarized separately in Table 3-2. This data is discussed further in Subsection 3.7.

Long-term Landfill Gas Monitoring. As part of scheduled monitoring activities, landfill gas samples have been collected annually from each of 18 gas vents at the landfill and analyzed in the field by direct-reading instruments. Monitored parameters are listed below.

- total VOCs (ppm)
- percent oxygen
- hydrogen sulfide (ppm)
- percent of lower explosive limit
- carbon monoxide (ppm)
- percent carbon dioxide
- percent methane

The Army has included tabulated analytical results for the landfill gas monitoring and submitted them to USEPA and MADEP annually (SWET, 1997a; SWET, 1997b; SWET, 1998; USACE, 1999; USACE, 2000). Appendix B contains summary tables of the data collected during the landfill gas monitoring program.

The purpose of the landfill gas monitoring program is to establish long-term trends with regard to landfill gas production and venting. Review of the monitoring data for 1996, 1997, and 1998, shows somewhat variable but low concentrations of target parameters. In 1999 sampling procedures were changed in an effort to obtain more representative samples. In addition, two rounds of sample collection were performed: one round during a period of falling barometric pressure and one round during a period of rising barometric pressure. The effects of the revised sampling procedure and the influence of changing barometric pressure appear clearly evident in the data; the 1999 data, particularly the data associated with falling barometric pressure, are

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higher than historic data. The 1999 Annual Report (USACE, 2000) showed lower explosive limits exceeding 100 percent at 16 of 18 gas vents, and methane concentrations ranged from 0.8 to 32.8 percent. These readings are within the parameters of a mature landfill (USACE, 2000).

The gas vents appear to be functioning properly. The transition from high to low atmospheric pressure facilitates venting of landfill gas to the atmosphere, while the transition from low to high atmospheric pressure retards venting to the atmosphere. A concern, however, is possible subsurface migration of landfill gas to off-site locations. If the gas vent system is functioning properly there should not be subsurface migration; however, installation of subsurface probes to monitor for landfill gas migration along the northwest edge of the landfill is recommended.

Institutional Controls. The ROD proposed institutional controls in the form of zoning and deed restrictions for any property released by the Army at Shepley's Hill Landfill. No property has been released, and therefore no institutional controls have been implemented.

Educational Programs. No public meetings have been held or presentations given on Shepley's Hill Landfill since the public meeting on the proposed plan. However, Shepley's Hill Landfill is often discussed at the Restoration Advisory Board meetings, and, therefore, concerned members of the public are kept informed of activities at the landfill.

60 Percent Design of a Groundwater Extraction System. The Army prepared a 60 percent complete engineering design for groundwater extraction and discharge to the Town of Ayer POTW in 1997 (USACE, 1997).

Annual Reporting to MADEP and USEPA. Annual reports which include a description of site activities and a summary of results of environmental monitoring have been submitted annually to MADEP and USEPA (SWET, 1997a; SWET, 1997b; SWET, 1998; USACE, 1999; USACE, 2000). This reporting satisfies the requirements of 310 CMR 19.132 and 19.142. In addition, the Army submits semi-annual groundwater analytical reports that summarize analytical data.

Five-year Site Reviews. In accordance with the schedule set forth in the ROD, the Army completed the first five-year review for Shepley's Hill Landfill in 1998 (SWET, 1998). The review summarized site activities and monitoring activities and compared achieved risk reductions to risk-reduction goals. Data presented in the review show that reductions in arsenic concentrations and corresponding risk satisfied the evaluation criteria at nine of eleven historical groundwater monitoring wells. Only monitoring wells SHL-10 and SHL-11 did not achieve risk-reduction goals. It was concluded, however, that substantial progress had been made toward achieving cleanup levels and, in light of the fact that there was no exposure to groundwater, implementation of contingency remedial action was not justified at that time. The following table summarizes the conclusions of the 1998 Five Year Review for Shepley's Hill Landfill (SWET, 1998).

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MONITORING WELL	MONITORING WELL MET 1998 INCREMENTAL CLEANUP GOALS
SHL-3	Yes
SHL-4	Yes
SHL-5	Yes
SHL-9	Yes
SHL-10	No
SHL-11	No
SHL-19	Yes
SHL-20	Yes
SHL-22	Yes
SHM-93-10C	Yes
SHM-93-22C	Yes
SHM-96-22B	Not evaluated, no baseline.
SHM-96-05B	Not evaluated, no baseline.
SHM-96-05C	Not evaluated, no baseline.

Data from monitoring wells installed in 1996 to fill gaps in the spatial coverage at the north end of the landfill (i.e., monitoring wells SHM-96-05B, -05C, and -22B) showed arsenic concentrations up to two orders of magnitude greater than historical values in older wells. In accordance with criteria presented in the ROD, because baseline data were not available for these new monitoring wells, they were not used in the assessment of remedy effectiveness. However, because the high observed concentrations and potential for off-site migration were of concern to the Army, USEPA, and MADEP, the Army agreed to perform supplemental groundwater investigations at Shepley's Hill Landfill to assess groundwater flow, arsenic migration, and potential exposure risk (HLA, 1999).

Shepley's Hill Landfill Supplemental Groundwater Investigation. The purpose of the Supplemental Groundwater Investigation was to support the Long Term Monitoring and Maintenance Plan for Shepley's Hill. The investigation focuses on arsenic and is intended as a tool to guide decision making concerning further investigative activities at Shepley's Hill Landfill. It is neither a baseline risk assessment nor an assessment of the protectiveness of the selected remedial action at Shepley's Hill Landfill. The Shepley's Hill Landfill Supplemental Groundwater Report presents and discusses the results of those studies (Harding-ESE, 2000).

The Army performed the following activities to further investigate the interaction of groundwater and Shepley's Hill Landfill:

- assessing the effects of precipitation runoff on groundwater levels within the landfill;
- collecting hydrogeologic data to assess groundwater flow north of Shepley's Hill Landfill;
- collecting analytical data to characterize contaminant concentrations moving away from the landfill and physical-chemical factors affecting contaminant migration;

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- refining the Shepley's Hill Landfill groundwater model to further assess groundwater flow and potential contaminant transport north of the landfill; and
- re-evaluating potential human-health risks in light of new analytical data.

The Army also contacted several local and regional public health agencies in an effort to confirm the availability and use of a public water supply in the area downgradient of Shepley's Hill Landfill and to find out whether and to what extent private wells may be used in the area north of the landfill to supplement the public water supply. There are no public records of private wells downgradient of the landfill, but the presence of undocumented wells is possible.

Review of available analytical data indicates a well defined plume with elevated arsenic concentrations moving southeast to northwest away from Shepley's Hill Landfill and toward the wetland north of West Main Street in Ayer. In addition to high arsenic concentrations, groundwater in the center of the plume has a very low redox potential, high concentrations of dissolved (i.e., reduced) iron and manganese, very low to no dissolved oxygen (DO), and a chemical oxygen demand of 30 to 40 milligrams per liter (mg/L). These conditions are conducive to the continued migration of the arsenic toward the wetland.

The association of highly reduced groundwater and high concentrations of arsenic, iron, and manganese suggests that the arsenic in groundwater was released when iron and manganese oxides and oxyhydrides in the upgradient aquifer were reduced by landfill influenced groundwater. The conclusion is supported by the analytical results showing arsenic in samples from drill cuttings collected from Shepley's Hill Landfill monitoring wells.

If the reduced groundwater between Shepley's Hill Landfill and the wetland were to become oxidizing (i.e., aerobic) by mixing with oxygenated groundwater, then chemical reactions would occur in the aquifer which would result in arsenic being captured and its further migration halted. The likelihood that existing reducing groundwater conditions will change to oxidizing conditions through mixing in the aquifer is considered low, however.

The groundwater flow model suggests that most of the groundwater associated with Shepley's Hill Landfill flows north, discharging mainly to a section of Nonacoicus Brook in the wetland north of West Main Street. The pathway indicated by the model corresponds to distributions of contaminants seen in monitoring locations along Molumco Road. The Army did not collect samples to confirm the location of groundwater discharge to the wetland.

Based on available data there is no current use of, or exposure to, groundwater migrating away from Shepley's Hill Landfill, and no current human-health risk. However, to assess the potential for adverse effects if groundwater were to be used, the Army performed a brief assessment of potential risks to hypothetical residential users. Adult residential use of groundwater with arsenic at the concentrations found at Molumco Road, if it were to occur, would result in potential cancer risks of 6E-03 and non-cancer risks corresponding to an Hazard Index (HI) of 36. For a child resident, the corresponding cancer risk is 4E-03, and the HI is 110. The total resident cancer risk (child plus adult) is 1E-02. These risk levels exceed the USEPA target cancer risk range of 1E-06 to 1E-04 and target HI of 1.

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An ecological risk assessment to evaluate potential ecological risks from exposure to surface water and sediments in the Nonacoicus Brook wetland north of West Main Street was not performed because no sediment or surface water data were available. Potential ecological risks from exposure to Plow Shop Pond sediments were not updated from the assessments of the RI Addendum (ABB-ES, 1993) and draft Plow Shop Pond and Grove Pond Sediment Evaluation (ABB-ES, 1995c) reports.

High concentrations of arsenic in groundwater within the footprint of the landfill and at its downgradient edge suggest that arsenic concentrations in groundwater moving away from the landfill may become higher than present concentrations. However, absorption on downgradient overburden materials may retard arsenic migration and dilution/dispersion may lower arsenic concentrations.

3.4 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS REVIEW

ARARs are applicable or relevant and appropriate requirements under federal or state environmental or facility siting laws that address hazardous substances, pollutants, remedial actions, locations, or other circumstances at a CERCLA site. Location-specific ARARs “set restrictions upon the concentration of hazardous substances or the conduct of activities solely because they are in special locations.” Chemical-specific ARARs are usually health- or risk-based standards that limit the concentration of a chemical found in or discharged to the environment. Action-specific ARARs set controls or restrictions on activities related to the management of hazardous waste. Identified ARARs for the Shepley's Hill Landfill Operable are listed below. The standards listed below were identified as ARARs in the ROD. They were reviewed for changes that could affect protectiveness. Appendix B contains a copy of the ROD ARARs table for the Shepley's Hill Landfill Operable Unit.

Location-specific Requirements

- Floodplain Management Executive Order No. 11988, (40 CFR Part 6, App. A)(Applicable)
- Protection of Wetlands Executive Order No. 11990 (Applicable)
- Fish and Wildlife Coordination Act, (16 USC 661 et seq.; 40 CFR Part 302)(Applicable)
- Endangered Species Act, (16 USC 1531 et seq.; 50 CFR Part 402)(Applicable)
- Massachusetts Wetland Protection Act and Regulations, (MGL c. 131 s. 40; 310 CMR 10.00)(Applicable)
- Massachusetts Endangered Species Act and implementing regulations, (MGL c. 131A, s. 1 et seq.; 321 CMR 10.00)(Applicable)
- Areas of Critical Environmental Concern, (301 CMR 12.00)(Relevant and Appropriate)

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Chemical-specific Requirements

- Safe Drinking Water Act, National Primary Drinking Water Standards, MCLs, (40 CFR Parts 141.11-141.16 and 141.50-191.51)(Relevant and Appropriate)
- Massachusetts Surface Water Quality Standards, (314 CMR 4.00)(Applicable)
- Massachusetts Groundwater Quality Standards, (314 CMR 6.00)(Applicable)
- Water Standards and Guidelines, (310 CMR 22.00)(Relevant and Appropriate)
- Massachusetts Ambient Air Quality Standards, (310 CMR 6.00)(Relevant and Appropriate)
- Massachusetts Air Pollution Control Regulations, (310 CMR 7.00)(Relevant and Appropriate)

Action-specific Requirements

- Resource Conservation and Recovery Act, (Subtitle D, 40 CFR 258)(Relevant and Appropriate)
- Resource Conservation and Recovery Act, (Subtitle C, 40 CFR 260, 264)(Relevant and Appropriate)
- Massachusetts Solid Waste Management Regulations, (310 CMR 19.100)(Applicable)
- Massachusetts Hazardous Waste Regulations, (310 CMR 30.00)(Relevant and Appropriate)

Location-specific ARARs identified in the ROD for the Shepley's Hill Landfill Operable Unit include regulations that protect wetlands, floodplains, and endangered species (i.e., the Grasshopper Sparrow, a state listed species of special concern); however, Alternatives SHL-2 and SHL-9 do not involve any activities anticipated to trigger wetlands or floodplain ARARs. Landfill mowing must be performed to prevent or minimize adverse effects on the Grasshopper Sparrow and its habitat.

Identified chemical-specific ARARs include federal and state drinking water standards, state surface water and groundwater quality standards, and state air quality and air pollution control regulations. The water quality standards were considered during establishment of cleanup levels and the air quality regulations are used to evaluate alternative performance and protectiveness. Standards for the contaminants of concern have not become more stringent since the signing of the ROD in October 1996. However, on June 22, 2000, USEPA proposed reducing the MCL for arsenic from 50 to 5 µg/L (65 FR 38887-38983). Promulgation of a new standard is required by January 1, 2001; however, it probably would not take effect for 3 to 5 years. The background concentration for arsenic in groundwater at Devens RFTA ranges from 1.3 to 15.2 µg/L.

The ROD identified several action-specific ARARs for the Shepley's Hill Landfill Operable Unit; the most important are the ones relating to landfill cover systems and landfill closure. The Massachusetts Solid Waste Management Regulations at 310 CMR 19.000 have been identified as applicable. USEPA Regulations for Owners and Operators of Permitted Hazardous Waste Facilities at 40 CFR 264 (RCRA Subtitle C), and USEPA Criteria for Municipal Solid Waste

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Landfills at 40 CFR 258 (RCRA Subtitle D), and Massachusetts Hazardous Waste Management Rules at 310 CMR 30.000 have all been identified as relevant and appropriate.

The design of the existing cover system at Shepley's Hill Landfill was approved by MADEP in 1985 pursuant to the Massachusetts Sanitary Landfill regulations of 1971 (310 CMR 19.00). Provisions in the Massachusetts Solid Waste Management Regulations of 1990 (310 CMR 19.000) indicate that the conditions of the 1985 approval satisfy 310 CMR 19.000; therefore the existing cover is considered to comply with the applicable cover system requirements of 310 CMR 19.000. In addition, the existing cover meets the general performance standards of 310 CMR 19.000. The existing cover system also meets the performance standards of RCRA Subtitle C at 40 CFR 264.310, RCRA Subtitle D at 40 CFR 258, and Massachusetts Hazardous Waste Regulations at 310 CMR 30.000. The existing cover varies from USEPA guidance for RCRA final covers primarily in that it has a geomembrane hydraulic barrier rather than a composite hydraulic barrier. Alternatives SHL-2 and SHL-9, which rely on the existing cover, therefore comply with ARARs for cover systems. The long-term monitoring and maintenance plan is designed to comply with the applicable requirements of 310 CMR 19.000.

Action-specific ARARs for landfill post-closure requirements would be met by Alternatives SHL-2 and SHL-9. Alternative SHL-9, if implemented, would be required to meet the federal Clean Water Act General Pretreatment Requirements to discharge to the Town of Ayer POTW. Federal and state air quality regulations would be met by Alternatives SHL-2 SHL-9. Dust suppression techniques would be used, when necessary, to meet air quality regulations.

No newly promulgated ARARs or changes to ARARs have been identified that would affect the implementation of the selected remedy for the Shepley's Hill Landfill Operable Unit; however, a proposed revision to the MCL for arsenic could affect the arsenic cleanup level.

3.5 SUMMARY OF SITE VISIT

An HLA representative performed a site inspection of the Shepley's Landfill Operable Unit (AOCs 4, 5, and 18) on June 8, 2000. Conditions during the inspection were favorable with no precipitation and temperatures in the 60s. It should be noted that the Army performs detailed annual inspections of the landfill as part of the Long Term Monitoring and Maintenance Plan. The results of the inspections along with recommendations for follow-up maintenance action and documentation of maintenance activities performed during the previous year are reported to USEPA and MADEP annually (SWET, 1997a; SWET, 1997b; SWET, 1998; USACE, 1999; USACE, 2000).

Operation and maintenance of the landfill remained consistent with the specifications and restrictions outlined in the ROD. The inspection did not reveal any signs of disturbance on or near the landfill cap. Vehicular access to the landfill was controlled by a gate at the former DRMO yard at the southwestern corner of the landfill. The gate was closed at the time of the inspection. Tire ruts were observed adjacent to the access road that runs across the center of the landfill. The ruts were not deep enough to compromise the landfill cap. The grass over the

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landfill was recently mowed. Stormwater runoff appears to be effectively controlled both on the cap and to the north and east of the landfill. Monitoring well casings were intact and secured.

The following individuals were interviewed as part of the five-year review:

- Jim Chambers, BRAC Environmental Coordinator, Devens RFTA
- John Regan, MADEP
- David Margolis, USACE, New England District

All personnel were interviewed on June 8, 2000 at the Devens RFTA BRAC office. John Regan stated that the landfill cover has required repair as a result of ponding of stormwater runoff. Mr. Chambers added that the ponding was a condition that existed prior to the ROD, and repairs have been made to rectify the issue. Ponding is no longer a problem.

John Regan expressed the MADEP concern over the presence of dissolved arsenic in Shepley's Hill Landfill monitoring wells. Mr. Chambers noted that a supplemental groundwater investigation was underway to address the arsenic. Both Mr. Chambers and Mr. Regan said that the public has expressed concerns about the arsenic in groundwater.

No one was aware of any violations to the land use restrictions outlined in the ROD. Mr. Chambers stated that the Army has no plans to transfer ownership of the property.

Mr. Chambers stated that there have been minor problems caused by vehicles creating tire ruts on the landfill. As a result a greater effort has been made to keep the gate at the southwest corner of the landfill closed to prevent unauthorized access.

As a general comment, Mr. Regan said that MADEP wants to make sure that the data from the supplemental groundwater investigation definitively shows whether arsenic does or does not pose a risk to drinking water sources.

3.6 AREAS OF NON-COMPLIANCE

Deficiencies in implementation of the ROD were not identified during the five-year site review. Long-term monitoring and maintenance are being performed in accordance with the approved plan. Needed maintenance is identified during annual inspections and documented in the annual reports along with maintenance accomplished during the previous year.

Some damage has occurred to the landfill surface as result of uncontrolled vehicle access. The Army has closed access to prevent unauthorized access to the landfill. Incremental risk reduction was reviewed in 1998 in accordance with the schedule in the ROD. Difficulties in achieving cleanup goals are discussed in Subsection 3.7.

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3.7 ASSESSMENT

Question A: Is the Remedy Functioning as Intended by the Decision Documents?

Implementation of Institutional Controls and Other Measures: There are no current or future plans for transfer of ownership of the property at Shepley's Hill Landfill. Therefore implementation of institutional controls is not required at this time. Controls would be implemented if property were transferred.

Remedial Action Performance: The ROD stipulates that calculation of incremental reduction of risk to evaluate remedy protectiveness and assess progress toward attainment of groundwater cleanup goals will occur at five-year intervals in 1998, 2003, and 2008. The first five-year review for Shepley's Hill Landfill was performed in 1998 (SWET, 1998). The review summarized site activities and monitoring activities and compared achieved risk reductions to risk-reduction goals. Data presented in the review show that reductions in arsenic concentrations and corresponding risk satisfied the evaluation criteria at nine of eleven historical groundwater monitoring wells; only monitoring wells SHL-10 and SHL-11 did not achieve risk-reduction goals. It was concluded, however, that substantial progress had been made toward achieving cleanup levels and, in light of the fact that there was no exposure to groundwater, implementation of contingency remedial action was not justified at that time.

The second detailed assessment of incremental risk reduction is not scheduled until 2003. However, because arsenic is the predominate contributor to risk at Shepley's Hill Landfill, review of the data in Table 3-2 enables assessment of cleanup progress. Review of that data shows that, based on November 1999 data, the cleanup goal of 50 µg/L has been maintained or met at 8 of 14 monitoring wells (see table below).

SUMMARY OF ARSENIC REDUCTION		
MAINTAINED OR ACHIEVED CLEANUP LEVEL	SUBSTANTIAL REDUCTION SINCE OCTOBER 1997	LITTLE OR NO REDUCTION SINCE OCTOBER 1997
SHL-3 SHL-5 SHM-96-05C SHL-9 SHL-10 SHM-93-10C SHL-22 SHM-93-22C	SHL-4 SHL-19	SHM-96-05B SHL-11 SHL-20 SHM-96-22B

Further, substantial concentration reductions (approximately 75 percent compared to baseline) have occurred at two monitoring wells: SHL-4 and SHL-19; suggesting strongly that monitoring wells SHL-4 and SHL-19 will meet the 2003 incremental goal. However, little or no reduction is occurring at monitoring wells SHL-11, SHL-20, SHM-96-05B, and SHM-96-22B. In fact, concentrations at SHL-11, SHM-96-05B, and SHM-96-22B have increased since the October

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1997 sampling. At monitoring well SHL-20 arsenic concentrations have dropped only a few percent since 1998, and only 35 percent from baseline. The data in Table 3-2 suggest that 2003 incremental goals will not be met at monitoring wells SHL-11, SHL-20, SHM-96-05B, and SHM-96-22B. In light of the fact that the background concentration of arsenic at Devens RFTA ranges from 1.3 to 15.2 µg/L, and following review of Table 3-2, it is uncertain whether groundwater at Shepley's Hill Landfill could meet a cleanup goal corresponding to the proposed MCL of 5 µg/L.

System Operations/Operation and Maintenance (Long-term Groundwater Monitoring): Post closure monitoring and maintenance are being performed in accordance with the Long Term Monitoring and Maintenance Plan (SWET, 1996c).

Cost of System Operations/Operation and Maintenance: Yearly O&M costs for implementation of the remedy at each AOC were not available for review.

Opportunities for Optimization: The list of parameters monitored as part of the long-term groundwater sampling program should be reviewed with the intent of eliminating parameters that have no significant site history and that do not contribute to site risks or to the understanding of groundwater chemistry. These include cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, biochemical oxygen demand (BOD₅), and cyanide.

Early Indicators of Potential Remedy Failure: As discussed previously, little or no reduction in arsenic concentration is occurring at monitoring wells SHL-11, SHL-20, SHM-96-05B, and SHM-96-22B. In fact, concentrations at SHL-11, SHM-96-05B, and SHM-96-22B have increased since the October 1997 sampling. At monitoring well SHL-20 arsenic concentrations have dropped only a few percent since 1998, and only 35 percent from baseline. The data in Table 3-2 suggest that 2003 incremental goals may not be met at monitoring wells SHL-11, SHL-20, SHM-96-05B, and SHM-96-22B. Additional time is needed, however, to confirm whether arsenic concentrations will meet cleanup goals.

As discussed in the Shepley's Hill Landfill Supplemental Groundwater Report (Harding-ESE, 2000), several factors contribute to this situation. First, the association of highly reducing conditions and high concentrations of arsenic, iron, and manganese in groundwater samples from at monitoring wells SHL-11, SHL-20, SHM-96-05B, and SHM-96-22B suggests that the arsenic in groundwater was released when iron and manganese oxides and oxyhydrides in the upgradient aquifer were reduced by landfill influenced groundwater. Second, groundwater model simulations without the landfill cap indicate that the cap effectively diverts migration of groundwater away from Plow Shop Pond and monitoring wells SHL-3, SHL-4, SHL-10, and SHL-19. This diversion is evident in the improvements in groundwater quality at these wells. Finally, groundwater flow modeling suggests that most of the groundwater associated with Shepley's Hill Landfill flows north, discharging mainly to a section of Nonacoicus Brook in the wetland north of West Main Street; monitoring wells SHM-96-05B and SHM-96-22B are located such that they intercept this redirected groundwater flow as it moves north. Figures 3-3 and 3-4 show modeled groundwater flow with and without the landfill cap, respectively.

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Question B: Are the Assumptions Used at the Time of Remedy Selection Still Valid?

Changes in Standards and To Be Considered: This five-year review did not identify ARARs that have been promulgated since the ROD was signed. However on June 22, 2000, USEPA proposed reducing the MCL for arsenic from 50 to 5 µg/L. Promulgation of a new standard is required by January 1, 2001; however, it likely would not take effect for 3 to 5 years. Attainment of the proposed standard would increase the stringency of the groundwater cleanup, and would reduce the potential residual risk from exposure to groundwater.

Changes in Exposure Pathways: No changes in the site conditions that affect exposure pathways were identified as part of this five-year review. First, there are no current or planned changes in land use at Shepley's Hill Landfill. Second, no new contaminants, sources, or routes of exposure were identified as part of this five-year review. Further, there is no indication that hydrologic/hydrogeologic conditions are not adequately characterized. Finally, there are no identified users or exposure to downgradient groundwater.

Changes in Toxicity and Other Contaminant Characteristics. The ROD based the cleanup level for manganese on background concentrations because background concentrations at Devens RFTA exceeded the risk-based concentration derived from the then available RfD value (5×10^{-3} milligrams/kilogram/day). A revised/updated RfD (4.7×10^{-2}) (USEPA Region 1 Risk Updates, Nov. 1996), available when the Long-term Monitoring and Maintenance Plan was prepared, was used in the Long-term Monitoring and Maintenance Plan to calculate a revised cleanup level for manganese of 1,715 µg/L.

Changes in Risk Assessment Methodologies: Identified changes in risk assessment methodologies since the time of the ROD are discussed in the previous bulleted item "Changes in Toxicity and Other Contaminant Characteristics". These changes do not call into question the protectiveness of the remedy.

Question C: Has any other information come to light that could call into question the effectiveness of the remedy?

As discussed in "Early Indicators of Potential Remedy Failure", little or no reduction in arsenic concentration is occurring at monitoring wells SHL-11, SHL-20, SHM-96-05B, and SHM-96-22B. In fact, concentrations at SHL-11, SHM-96-05B, and SHM-96-22B have increased since the October 1997 sampling. At monitoring well SHL-20 arsenic concentrations have dropped only a few percent since 1998, and only 35 percent from baseline. The data in Table 3-2 suggest that 2003 incremental goals may not be met at monitoring wells SHL-11, SHL-20, SHM-96-05B, and SHM-96-22B. Additional time is needed, however, to confirm whether arsenic concentrations will meet established cleanup goals.

Review of topographic maps for Shepley's Hill Landfill and vicinity show the presence of a number of topographic features (i.e., linears) potentially indicative of bedrock fracturing. Extensive bedrock fracturing, if present, could play a role in the migration of contaminated groundwater and arsenic; however, the significance of the observed topographic features and

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presence of significant fractures is unproven. While some fractures undoubtedly exist in bedrock at Shepley's Hill Landfill, the majority of data indicate a competent low water yielding matrix.

In light of the fact that the background concentration of arsenic at Devens RFTA ranges from 1.3 to 15.2 µg/L, and following review of Table 3-2, it is uncertain whether groundwater at Shepley's Hill Landfill could meet a cleanup goal corresponding to the proposed MCL of 5 µg/L.

3.8 RECOMMENDATIONS

The Army should continue with its programs of annual landfill inspections and landfill gas sampling, and semi-annual groundwater sampling with annual reporting to USEPA and MADEP. Landfill maintenance should continue as recommended in the Long Term Monitoring and Maintenance Plan and in the annual reports.

The list of parameters monitored as part of the long-term sampling program should be reviewed with the intent of eliminating parameters that have no significant site history and that do not contribute to site risks or to the understanding of groundwater chemistry. These include cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, BOD₅, and cyanide. Analysis of TOC in lieu of BOD₅, would provide insight on the concentration of organic material in groundwater which is not currently available.

Samples from groundwater monitoring wells (i.e., SHM-99-31A, SHM-99-31B, SHM-99-31C, and SHM-99-32X) installed along Molumco Road north of Shepley's Hill Landfill should continue to be analyzed for arsenic, iron, manganese, and the general chemistry and field parameters monitored as part of the long-term sampling for the landfill. Samples from these monitoring wells will be used in the continuing assessment of arsenic migration north of the landfill.

Although landfill-gas readings are within the parameters of a mature landfill and landfill-gas vents appear to be working properly, because of high landfill-gas measurements during routine sampling, the Army should assess whether subsurface migration of landfill gas is occurring.

The contingency remedy of groundwater extraction with subsequent discharge to the Town of Ayer POTW should be re-evaluated by the Army. Although groundwater extraction has the potential to contain groundwater contaminants, it will not prevent the release of arsenic from aquifer materials and would need to be performed for an indeterminate length of time. Also, it appears that the POTW would no longer be suitable for receipt of extracted groundwater. These studies should be completed prior to the 2003 assessment of risk at Shepley's Hill Landfill.

3.9 PROTECTIVENESS STATEMENT

The remedy at Shepley's Hill Landfill Operable Unit is currently protective of human health and the environment. There are no known users of groundwater along the modeled downgradient path of

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groundwater leaving landfill area, although the presence of undocumented wells is possible. Further, the remedy directs groundwater flow away from Plow Shop Pond.

A HASP and investigation derived waste (IDW) handling procedures are in place, are sufficient to control risk to on-site workers and the public, and are being properly implemented during groundwater sampling. Human health is currently not at risk at Shepley's Hill Landfill Operable Unit because groundwater is not being used for potable use nor proposed for potable use.

3.10 NEXT REVIEW

The Shepley's Hill Landfill Operable Unit is a statutory site that requires ongoing five-year reviews. This is the second five-year review that has been performed at this operable unit; the first was performed in 1998, according to the schedule in the ROD. The next review will be performed within five years of the completion of this five-year review report; however, risk reduction will be evaluated in conformance with the ROD in 2003. The completion date is the date on which USEPA issues its letter to the Army either concurring with report's findings or documenting reasons for nonconcurrence.

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